



Brown & Root Environmental

A Division of Halliburton NUS Corporation

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Foster Plaza VII
661 Andersen Drive
Pittsburgh, PA 15220-2745

(412) 921-7090
FAX: (412) 921-4040

MEMORANDUM

C-49-10-5-249

TO: DISTRIBUTION

FROM: MATT COCHRAN, PROJECT MANAGER

DATE: DECEMBER 19, 1996

**REFERENCE: CLEAN CONTRACT NUMBER N62472-90-D-1298
CONTRACT TASK ORDER NUMBER 0187**

**SUBJECT: TRANSMITTAL OF OCTOBER RAB AND REVISED AUGUST RAB
MEETING MINUTES
MCAS CHERRY POINT, NORTH CAROLINA**

On behalf of MCAS, Cherry Point, enclosed are the minutes from the October 8, 1996 RAB Meeting (See Enclosure 1). I have also included a copy of the August 22, 1996 RAB Meeting minutes which were revised based on comments received from Alex Cardinell during the October meeting (See Enclosure 2).

If you have any questions regarding this matter, please contact me at (412) 921-8418.

Very truly yours,

Matthew G. Cochran
Project Manager

MGC/sic

Enclosures

Distribution with enclosure:

Ms. Grace B. Evans, Community Co-chair
Ms. Patricia D. McClellan-Green, Community Member
Mr. Lewis E. Mitchell, Community Member
Mr. Neil H. Scarborough, Community Member
Mr. Henry P. Sermons, Community Member
Mr. Eugene P. Smith, Community Member
Mr. Lance Laughmiller, LANTDIV
Ms. Christine Kartman, MCAS, Cherry Point
Ms. Renee Henderson, MCAS, Cherry Point
Ms. Rachel Johnson, MCAS, Cherry Point

Captain Jeffrey Hearn, MCAS, Cherry Point
Mr. Jay Bassett, United States Environmental Protection Agency
Ms. Linda Raynor, North Carolina Department of Environment, Health and Natural Resources
Ms. Cynthia Tschaepe, OHM Remediation Services
Mr. Tom Augspurger, United States Fish and Wildlife Service
Mr. Alex Cardinell, United States Geological Survey
Ms. Lauren Hillman, United States Forest Service
Mr. John Lindsay, National Coastal Resources Coordinator
Ms. Beth Hartzell, North Carolina Department of Environment, Health and Natural Resources
Mr. Richard Powers, North Carolina Department of Environment, Health and Natural Resources
Ms. Vicki Smith, Agency for Toxic Substance and Disease Registry
Mr. Roger Boucher, Northern Division (letter)
Mr. John Trepanowski, Brown & Root Environmental, Wayne
Mr. Joseph Farrell, Brown & Root Environmental, Wayne (letter)
Mr. Daryl Hutson, Brown & Root Environmental, Pittsburgh
Ms. Betsy Horne, Brown & Root Environmental, Wilmington
Mr. Gregory Zimmerman, Brown & Root Environmental, Pittsburgh
CTO 0187, CLEAN Central File

ENCLOSURE 1

**CHERRY POINT MARINE CORPS AIR STATION
RESTORATION ADVISORY BOARD MEETING
OCTOBER 8, 1996
MINUTES**

The RAB meeting was held at the Hampton Inn in Morehead City. Community members present were Pat McClellan-Green, Henry Sermons, Eugene Smith, and Neil Scarborough. Other RAB members present are Navy and Marine Corps members: Lance Laughmiller (LANTDIV), Renee Henderson and Rachel Johnson (MCAS EAD); regulatory members Linda Raynor and Richard Powers (NCDEHNR), and Jay Bassett (EPA); and Natural Resource Trustee Alex Cardinell (USGS). Also present were Bill Mullen (LANTDIV), Karen Craig and Christine Kartman (EAD); Cynthia Tschaepe (OHM); Susan Debuque (Management Edge); and Matt Cochran and Greg Zimmerman (B&RE). Melinda Landry was a guest. The meeting began at 7:05 and ended at 9:15.

Rachel Johnson, the Marine Corps Co-Chair, Opened the meeting and provided an overview of the agenda. Self introductions were made around the table.

Miscellaneous Topics

A copy of the RAB meeting public notice was circulated. Rachel indicated that the notice had been published in The Sun Journal, Havelock News, and the Carteret County News - Times.

The August 22 RAB meeting minutes were discussed. Several comments were forwarded to Matt Cochran by Alex Cardinell. Matt will revise and reissue the minutes based on the newly received comments.

Greg Zimmerman and Pat McClellan-Green discussed the relationship of chlorine atoms to dioxin toxicity. Pat indicated that toxicity was related to the position of the chlorine atoms; in addition, Greg indicated that toxicity was based on the number of chlorine atoms.

Pat indicated that she was not familiar with the term "receptor" as it is used in the baseline human health risk assessment. In her experience, the term "receptor" meant something totally different than an entity (human or animal) exposed to contaminants at a hazardous waste site.

Pat is interested in providing an intern to Cherry Point's Environmental Department. Pat was asked to complete a questionnaire and return it to Rachel.

Rachel announced that a transcript is available upon request of the OU3 public meeting conducted on August 22.

A status sheet of the work being conducted at the individual operable units was handed out.

Question from Pat McClellan-Green: What is the status of issues at OU3?

Response from Linda Raynor: Comments were discussed today at the partnering meeting. One agenda item involved ecological issues previously identified at the last partnering meeting.

OU1 interim field work activities at the Site 16 Landfill and the Stripper Barn were discussed. Greg provided a brief overview of the activities, which include well installations, sampling, and a pumping test.

Human Health Risk Assessment Presentation

Greg provided an overview of human health risk assessment approaches. A copy of the overheads is included in Attachment 1.

A human health risk assessment consists of a quantitative and qualitative evaluation to determine if cancer risks or non-cancer risks are probable from contamination at a site.

The purpose of a risk assessment was defined:

- 1) characterize and document the magnitude of human health and environmental risks
- 2) determine if remedial actions are needed
- 3) obtain information to support a "no action" remedial alternative
- 4) refine preliminary clean-up goals

Human health risk assessments contain five components: data evaluation, exposure assessment, toxicity assessment, risk characterization, and uncertainty analysis. Each component was discussed in detail. Major points of the presentation:

- Health effects can occur only where a complete exposure route to a receptor exists. If an exposure route does not exist, no risk exists.
- Examples of exposure routes include dermal (skin) contact and ingestion (swallowing) of groundwater and soil.
- Each contaminant exposure concentration is determined by statistics. The exposure mass (body weight) that is available for contact is based on EPA guidance.
- Toxicity assessment involves gathering both cancer causing (carcinogenic) and non-cancer toxic data for specific chemicals. The cancer slope factor, developed for cancer risk, represents the upper limit that would cause a receptor to develop cancer from a dose of a given chemical. Reference doses, developed for non-cancer risks, represent the maximum dose at which a human receptor would not realize adverse effects. Toxicity information is obtained from various USEPA sources.
- Carcinogenic risks are developed by calculating an Incremental Cancer risk value; noncarcinogenic risks are developed by calculating a hazard quotient value. The EPA typically deems acceptable risk assessment calculations that fall within the 10^{-6} (one in million) to 10^{-4} (one in a 10,000) range for carcinogenic effects and a value of one for the hazard quotient. A cumulative or total risk is developed, combining individual risks along all pathways.
- Uncertainty addresses the level of confidence in the assessment. Extrapolation of animal data to humans and the amount of a contaminant available for exposure are examples of assumptions used in risk assessments. The calculated risk is typically overestimated to compensate for risk assessment uncertainty.

Richard Powers indicated that synergistic (compounded) effects of multiple chemicals are also considered in the risk evaluation. Greg indicated that chemicals impacting typical target organs are addressed in the uncertainty section.

Greg cited one example where the lethal dose for salt is lower than the lethal dose for Trichloroethene (TCE).

Question from Eugene Smith: What is the government's liability in the event of developing cancer from a site?

Response from Jay Bassett: I know of no cases where a suit was filed and won as the result of adverse human health effects from a waste site. Greg mentioned that the American Cancer Society believes that one in three individuals will develop cancer and one in five will die from cancer as a result of daily factors. It is difficult to determine whether that risk is derived from a waste site or from other risk factors.

Rachel circulated copies of a handout titled "What one in a Million Means". A copy is enclosed as Attachment 2.

Comment from Eugene: I know of an example where contaminated surface water sediments are not being cleaned up because a removal action could disturb the contaminants and cause a bigger problem.

Response from Renee Henderson: That is correct. Cases also exist where uncontaminated sediments have deposited on top of contaminated sediments, effectively capping the contamination in place. This natural process eliminates contact potential with the contamination.

Question from Christine Kartman: Do the chemical intake values vary between children and adults?

Response from Greg: Yes.

Question from Rachel: Were soil samples collected in "background" areas?

Response from Greg: Yes. Soil samples were collected in areas removed from industrial activities. That data is statistically evaluated when possible, and is then compared with site-related compounds. Metals are typical background compounds.

Response from Jay: Organic compounds typically are not eliminated from evaluation in the risk assessment since they are not typically found in "background" soils.

Response from Greg: DDT is a good example of a pesticide compound that may be present because of widespread use but is not site related.

Response from Pat McClellan-Green: Pesticides were detected at OU2 but are not a contaminant of significant concern.

Question from Gene: The public's primary concern is the cleanup cost. What is the primary determinant or "driver" in identifying the cleanup level?

Response from Lance Laughmiller: The contaminant posing the greatest risk is used to determine the cleanup concentrations. Cost is also a factor in selecting remedial alternatives.

Response from Richard: The State of North Carolina has adopted very conservative standards; the regulatory requirement is to protect the state's natural resources. North Carolina is in the process of developing risk-based corrective action strategies, which should be issued within the next year.

OU2 Presentation

Several questions / comments were asked concerning the OU2 documents:

Question from Pat: Are there any shallow wells used for drinking water at the site?

Response from Greg: No.

Question from Pat: How can there be "background volatile compounds"?

Response from Greg: The samples collected in "background" areas were analyzed for volatile organic compounds. Hence, the term "background" is used to denote these samples.

Question from Pat: Page ES4 and page 18 of my copy of the document have compounds that are manually crossed out. Is this correct or do I have draft pages that should not be included in my version of the document?

Response from Matt Cochran: I do not know. It is possible that a page from another document was inadvertently inserted in the document. I will look into this and get back to you.

Comment from Pat: Compounds are pervasive at the site and it may be difficult to address them all.

Response from Greg: It may not be cost effective to address contaminant source areas. An alternate approach would be to intercept the contaminated groundwater along surface water boundaries.

Question from Melinda Landry: Will hotspots identified at OU2 have to be addressed?

Response from Linda Raynor: Hotspots identified to date would have to be addressed.

Question from Pat: What would happen if there were hotspots that contained metals? Would they have to be addressed?

Response from Linda Raynor: Only two metals have been identified that exceed standards and those compounds are not a concern.

Community Outreach Discussion

Rachel provided an overview of potential means of public outreach. Eugene asked if we know the percentage of the public that is concerned about the site. Rachel indicated that the level of concern is not known at this time. Alex Cardinell indicated that a brochure may be appropriate for community outreach. Henry agreed and also indicated that TV and radio may not be a cost-effective means of public communication.

Other methods of educating the public, including circulating a brochure to civic groups, chamber of commerce, etc, were discussed. The RAB agreed that a fact sheet / brochure would be appropriate. Rachel will discuss this approach with Grace. Gene suggested that a radio spot with a call in for questions may also be appropriate. Renee Henderson cautioned that the fact sheet should be timeless so it can be a useful outreach document over time. Rachel indicated that the RAB would be given an opportunity to review the fact sheet / brochure prior to finalization.

A mechanism to update the fact sheet may also be appropriate. Rachel and Grace will draft a version for review at the next meeting. The fact sheet / brochure may be created in two parts: a generic overview and a detailed insert that can be changed.

It was agreed that Pat will be added to the distribution list for team comments.

ENCLOSURE 2

**CHERRY POINT MARINE CORPS AIR STATION
RESTORATION ADVISORY BOARD MEETING
AUGUST 22, 1996
MINUTES**

The RAB meeting was held at the Havelock City Auditorium, to be followed by a public meeting on the preferred alternative for OU3. Community members present were Grace Evans, Pat McClellan-Green, and Neil Scarborough; Navy and Marine Corps members Lance Laughmiller (LANTDIV), Renee Henderson, and Rachel Johnson (MCAS CP EAD); regulatory members Linda Raynor and Richard Powers (NCDEHNR), and Gena Townsend and her successor, Jay Bassett (EPA); and Natural Resource Trustee Alex Cardinell (USGS). Also present were Waverly Hampton (LANTDIV); Marybeth Fennell (EAD); Cynthia Tschaepe (OHM); Susan Dubuque (Management Edge); and Matt Cochran, Greg Zimmerman, and Betsy Horne (B&RE). Henry Sermons had called to say he was on vacation. Other community members not present were Lew Mitchell and Gene Smith. The meeting began at 7:05 pm and ended at 8:00 pm.

Rachel Johnson, the Marine Corps Co-Chair, began by asking if the members had received the last meeting's minutes, which stated that Grace Evans had been elected Community Co-Chair. Rachel emphasized the importance of each member contacting either Grace or Rachel if they were going to be unable to attend a RAB meeting.

Rachel also reviewed some housekeeping issues:

Those RAB members who did not sign the charter that was adopted at the last RAB meeting need to do so. The sheet was passed around for signatures. Linda Raynor promised to obtain Beth Hartzell's signature and return the original sheet to Rachel.

Rachel asked that each member identify an issue or concern that should be the focus of a RAB presentation or workshop. A sheet was passed around to record these issues. Those proposed include: risk to fish, bioaccumulation, DoD risk evaluation, human health risk assessment, cost controls, hydrology, remediation methods, and basic chemistry including degradation (dioxin, arsenic, PCBs. Jay Bassett will obtain ATSDR sheets on the list of contaminants that Rachel provides).

Rachel and Grace are anxious to enhance MCAS Cherry Point's community outreach program. Rachel passed around examples of fact sheets other bases have created and requested suggestions from the RAB members.

OU3 Presentation

Greg Zimmerman opened his presentation by indicating how MCAS Cherry Point would accept public comment on the proposed approach to OU3: by receiving oral comment at the public meeting scheduled to follow the RAB meeting, by considering comments written on a card at

the meeting, or by receiving written comment addressed to the MCAS Cherry Point Public Affairs Office no later than August 30.

Greg placed the OU3 action in perspective by stating that the meeting would be the third scheduled to elicit public comment on a proposed remedial approach to cleaning up discrete areas of contamination at the Air Station. The first was to address PCBs at Sites 5 and 17; the second, in June, was for OU1 groundwater contamination.

OU3 is comprised of Sites 6 and 7, combined because of their proximity and similarity of contamination. Site 6's three ponds were used from the 1940s to 1970s to dispose of fly ash from the power plant and from 1980 to 1994 of lime alum sludge from the drinking water treatment plant. Site 7, used from 1949 to 1955, was where waste petroleum and lubricants were burned, either in an incinerator or on the ground. Fly ash was disposed on the western portion of Site 7 that is now overgrown.

Greg reviewed the Superfund process: the remedial investigation studies the problem to determine the type of contamination present and how widespread it is; that information is the basis for the feasibility study, which identifies cleanup objectives, analyzes remedial technologies, evaluates the technologies against the nine EPA-mandated selection criteria; this information is used to develop a proposed remedial action plan, which presents all the foregoing in a short straight-forward document that also identifies the alternative that MCAS Cherry Point prefers to address site contamination. Once a public comment period is held on the proposal, a record of decision on the plan is signed, selecting the remediation approach that will be used. A period to design the remedial approach is followed by the cleanup action itself and long-term monitoring to ensure that the remedy is working as designed.

For OU3, MCAS Cherry Point has undertaken four major investigations and two supplemental studies to collect samples of soil, groundwater, surface water and sediment from Luke Rowe's Gut and Slocum Creek, as well as lime alum sludge. Analysis revealed:

- | | |
|----------|--|
| Site 6 - | metals, pesticides, and dioxin (soil)
metals, pesticides (groundwater) |
| Site 7 - | metals, PAHs, pesticides, and VOCs (soil)
metals, pesticides, PAHs, and VOCs (groundwater at levels above
the State of North Carolina standards) |

The human health risk assessment was conducted using the latest guidance from EPA, including evaluating current and future land uses and receptors. Maintenance workers and adolescent trespassers were the receptors evaluated under the current land use (vacant land). Construction workers, full-time employees, and adult/child residents were the receptors evaluated under a future land use (industrial and residential) scenario. These land uses were evaluated even though MCAS Cherry Point is not planning on using the land at OU3 for those purposes. Adult recreational users of Slocum Creek were also evaluated.

The results of the human health risk assessments indicated that no "unacceptable risks" exist under current conditions and that the only receptors exposed to "unacceptable risks" were the construction workers at Site 7 and the adult/child residents at both Sites 6 and 7. The risks

would be the results of drinking the groundwater in the surficial aquifer. The surficial aquifer at MCAS Cherry Point is currently not used.

In addition, lead was detected in the soil at Site 7 at levels above EPA screening levels for soils in industrial and residential settings.

The ecological risk assessment evaluated the effect of the contamination on the eastern cottontail rabbit, the red fox, and the red tail hawk.

Greg reviewed the nine criteria EPA has established against which each alternative must be evaluated. Seven alternatives were considered in the feasibility study. These include:

1. Sites 6 and 7: No action
2. Sites 6 and 7: Institutional controls
3. Site 7: In-situ fixation/solidification of surface soils; Sites 6 and 7: Institutional controls
4. Site 7: Excavation and offsite disposal of surface soils; Site 6 and 7: Institutional controls
5. Site 7: Excavation, onsite ex-situ fixation/solidification and reuse of surface soils as fill; Sites 6 and 7: Institutional controls
6. Site 7: Soil cover; Sites 6 and 7: Institutional controls
7. Site 7: Partial dewatering, excavation, and offsite disposal of surface/subsurface soils; Sites 6 and 7: Institutional controls

The proposed approach is to implement alternative 2, institutional controls, which includes enclosing a portion of Site 7 with an 8-foot fence and posting warning signs in the area, as well as instituting long-term monitoring for OU3. Limits on the use of the surficial aquifer and portions of Site 7 would be memorialized in the MCAS Cherry Point Master Plan. The Plan is similar to a zoning map, detailing each area of the Station and what plans exist for them. Greg added that the objectives of the remediation were to prevent people from being exposed to the contaminated soil or the contaminated groundwater now or in the future. In addition, since the State has identified an area of soil with high benzene content coinciding with a plume of benzene in the groundwater, MCAS Cherry Point will begin to evaluate alternatives to remediate that area.

Comment from Pat McClellan-Green: She has a number of environmental management students for the academic year that would benefit from having a workshop on the MCAS Cherry Point IR program. One of them may also be interested in interning for the IR program.

Response by Rachel Johnson: Rachel and Renee will contact her directly to discuss both matters.

Question from Alex Cardinell: Was there a head differential between the Surficial Aquifer and the Yorktown Aquifer at OU3?

Response by Greg Zimmerman: Yes. It is a situation we have encountered throughout MCAS Cherry Point near surface water bodies.

Question from Grace Evans: Was there a comparison made of contaminant levels between the surface and subsurface soil? What effect might it be having?

Response by Greg: The fly ash was deposited in the 1950s and has been exposed to the elements for the last 40 years. All soil samples were collected in the space from the top of the water table to the soil surface. There was not much difference in levels and it does not appear that Luke Rowe's Gut or Slocum Creek are being impacted. Groundwater samples indicate very low contaminant levels are present. Linda Raynor added that benzene and gasoline have leached out of the soil and into the groundwater.

Question from Grace Evans: What is a receptor?

Response by Greg: A receptor is anything that is at risk from a source of contamination through contact from skin exposure or ingestion (eating or drinking). Adult activities like smoking at contaminated sites are a form of hand-to-mouth exposure to the contamination. Also, children often eat dirt as they play on the ground.

Question from Lance Laughmiller: How readily do site-related contaminants leach?

Response by Greg: PAHs do not readily leach because they bind to the soil. Petroleum contamination in the subsurface soils has stayed there.

Question from Grace: Isn't that unusual?

Response by Gena Townsend: Components of gasoline can remain in subsurface areas for a long time, even years. Lance added that the degradation process can take decades to complete.

Comment from Pat McClellan-Green: You've indicated that the contamination is sporadic. Please explain.

Response by Greg: The contamination at Site 7 is not found throughout the site. Most of it is in one location. The benzene plume is beneath only part of the site.

Question from Alex Cardinell: What did you find is happening to the plume? Is it migrating or dissipating?

Response by Greg: In the well that has been sampled three or four times since 1991, levels have dropped. Samples from wells adjacent to Luke Rowe's Gut reveal no groundwater contamination and surface water samples from both Luke Rowe's Gut and Slocum Creek show no risk.

Question from Jane Sharpe, Grace's guest: Just how serious is it that you have found dioxin?

Response by Greg: Many types of dioxin exist. The kind found at OU3 contains high levels of chlorine, which are the less toxic form of dioxin. The levels found are below the unacceptable risk levels established by EPA and the State.

Question from Jane Sharpe: What is the risk to people who live and work on the Station?

Response by Greg: Human health risk assessments will be conducted for each operable unit. No overall assessment can be determined otherwise.

Question from Waverly Hampton: What about the PAHs discovered?

Response by Greg: PAHs are commonly found at locations wherever material has been burned.

Question from Grace: How many wells have been installed?

Response by Greg: There are 16 wells on either side of Luke Rowe's Gut.

Question from Rachel Johnson: What are ARARs?

Response by Greg: They are the federal and state regulations and guidance that must be complied with in determining how the site should be remediated.

Question from Alex: Does a facility exist that could treat the benzene?

Response by Greg: A soil venting process (like a vacuum) could be employed that would produce no dust. Air sparging or bio solve could be used to degrade the benzene.

Question from Alex: Is there a code to document the groundwater model you used? Our groundwater specialist was not familiar with it.

Response by Greg: Brown & Root combined a couple of models to create the one used for OU3. Matt Cochran added that Corry Rich had been dealing with Jody Eimers at USGS.

Question from Waverly: Did the ecological risk assessment look at the typical critters?

Response by Greg: A site visit revealed no stressed vegetation or wildlife at OU3. Although the ecological risk assessment evaluated the risk to ingesting fish, no fish samples have been taken.

Question from Alex: Are there any shellfish in Slocum Creek and could these shellfish be used as bioindicators?

Response by Grace and Pat: OU3 is located in closed water, which is not conducive to shellfish habitat. However, shellfish would be bioaccumulators and indicators of water and sediment contamination levels. Gena added that no fish samples were collected, consistent with EPA requirements. No risk-based concern was triggered by the results of the initial screening. If the screening results do not exceed the triggering level, no hard core sampling is necessary.

Pat pointed out that the fish that have died are not sediment dwellers.

Question from not recorded: Why was a treatment technology not picked as the preferred alternative?

Response by Greg: Lead is not mobile in the environment. Since the fence would prevent anyone from being exposed to the contaminated soil, no traditional technology was needed to meet the OU3 remediation objectives. The estimated fence cost is about \$26,000 to construct, with maintenance of about \$432,000 over 30 years. In contrast, alternative 7, the most aggressive of the alternatives evaluated, generated an estimated \$2.6 million in construction costs. Even if all the soil was excavated, long-term monitoring would be required.

Question from Grace: Would it be worth planting biota such as the Indian mustard plant at OU3 to take up some of the metals?

Response by Greg: The location of the highest concentrations of lead is in that portion of Site 7 that is inaccessible and overgrown with vegetation. The flat area does not contain high lead levels.

Question from not recorded: Are you seeing any uptake of lead in local vegetation?

Response by Greg: That has not been evaluated.

Information generated as Pat asked a series of questions based on her review of the OU3 documents included:

Latex gloves are often the cause for phthalate ester detections during the laboratory analysis.

Signs will be placed along the edge of Luke Rowe's Gut and Slocum Creek.

Language in the ROD will need to be approved by the State in order to ensure that the benzene remaining in soil locations is guaranteed to be addressed.

More surface water samples will be taken at Site 7 around the flat area.

The work at Site 6 is not being done because of any risk, but rather as a part of general maintenance.

Jay Bassett was introduced. Jay will be succeeding Gena as EPA's Remedial Project Manager for MCAS Cherry Point. He has worked for EPA for 6 years, preceded by work for the Navy. Jay begins as EPA's RPM on August 23.

The next RAB meeting will be scheduled for sometime in October. [At the Partnering meeting the following morning, a decision was made to tie the next RAB meeting to the date and location of the next Partnering meeting. The October Partnering meeting is scheduled for October 8 at the Hampton Inn in Morehead City.]

ATTACHMENT 1

Purpose of Risk Assessment

Characterize and document the magnitude of human health and environmental risks

- **Determine if remedial actions are needed**
- **Obtain information to support a “no-action” remedial alternative**
- **Refine preliminary remediation goals**

Five Basic Components of a Baseline Human Health Risk Assessment

- **Data Evaluation**
- **Exposure Assessment**
- **Toxicity Assessment**
- **Risk Characterization**
- **Uncertainty Analysis**

Data Evaluation

- Compile existing

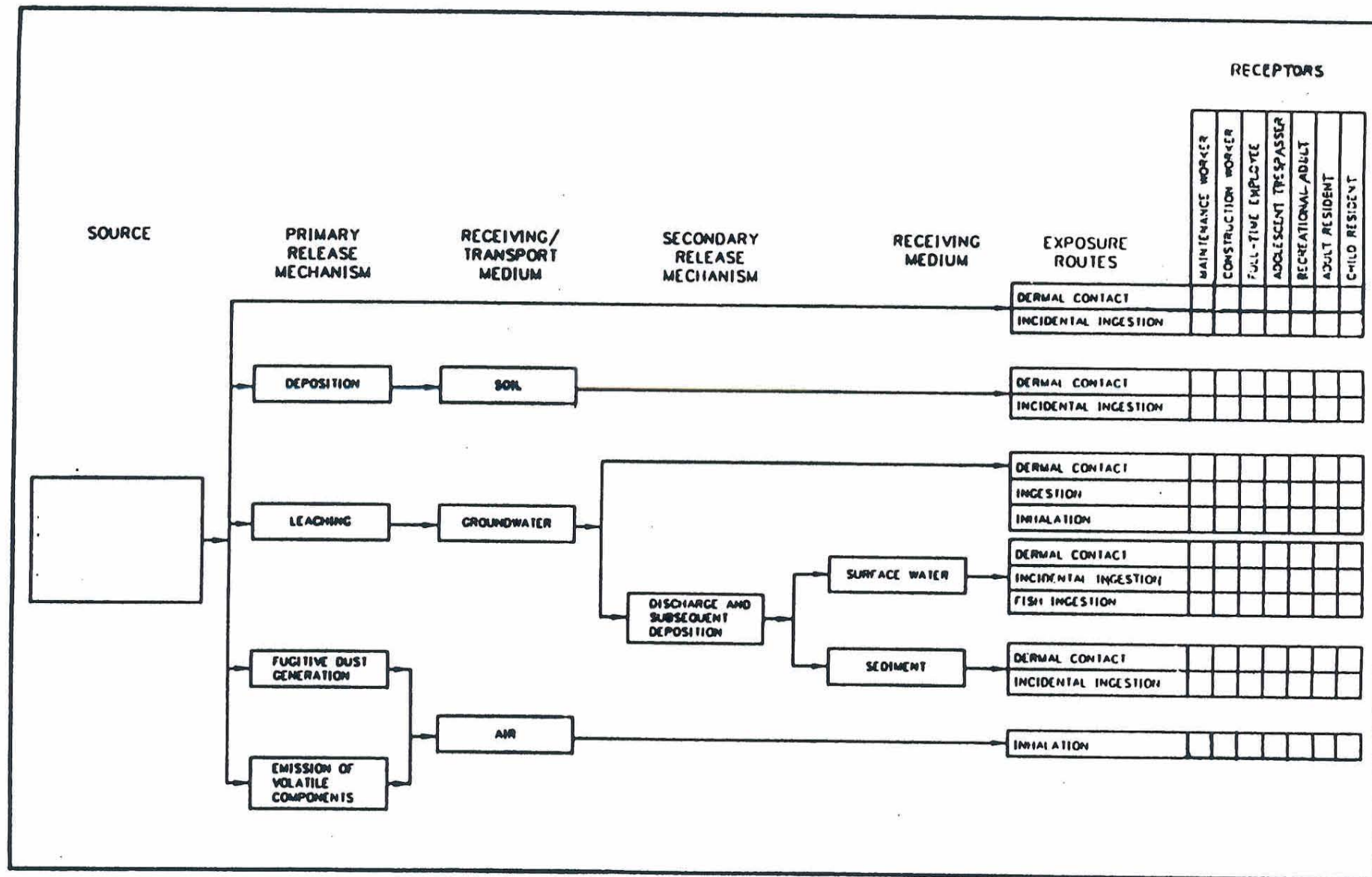
- Evaluate analytical data (i.e., analytical methods, quantitation limits, qualifier codes, tentatively identified compounds)

- Identify site-related constituents using established background levels and information on site activities

- Select Chemicals of Potential Concern (COPCs) using risk-based screening levels

Exposure Assessment

- Characterize physical setting
- Develop Conceptual Site Model (CSM)
 - identify chemical source(s)
 - identify migration pathways
 - identify potential exposure routes
 - identify potential receptors
- Estimate representative exposure concentrations (i.e., upper confidence limit, average, maximum)
- Estimate chemical intakes



CONCEPTUAL SITE MODEL



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Toxicity Assessment

Gather toxicological information for COPCs

- Determine appropriate Reference Doses (RfDs) for noncarcinogenic effects and Cancer Slope Factors (CSFs) for carcinogenic effects

Primary US Sources of Toxicological Information

Integrated Risk Information System (IRIS)

- **Health Effects Assessment Summary
Tables (HEAST)**
- **Environmental Criteria and Assessment
Office (ECAO)**

Risk Characterization

Quantify risks for individual COPCs by combining estimated chemical intakes (developed in Exposure Assessment) with toxicological information (compiled in the Toxicity Assessment)

- **Determine risks for potential receptors by combining risks for multiple COPCs across all applicable pathways**
- **Compare quantitative risks to benchmarks**

Typical Risk Assessment

Parameters

■ USEPA “target risk range” of $1E-6$ to $1E-4$
(for carcinogenic effects)

■ Hazard Index of 1 (for noncarcinogenic effects)

Generic Intake Equation

$$I = \frac{C \times CR \times EF \times ED}{BW \times AT}$$

Where:

I = Estimated chemical intake (mg/kg/day)

**C = Concentration of chemical in medium
(media-specific units, such as mg/L for water)**

CR = Contact rate (media-specific units, such as L/day for water)

EF = Exposure frequency (days/year)

ED = Exposure duration (years)

BW = Body weight (kg)

AT = Averaging time (days)

ATTACHMENT 2

What *One in a Million* Means?

	Incidents per year	Incidents per life time	Exposed population		Life time risks	
Death from motor vehicle accidents	46,000	3,200,000	200,000,000	1 in 62	0.0161	1.6%
Deaths from smoking	80,000	5,600,000	(35% smoke) 92,750,000	1 in 17	0.0604	6%
Reported cancer incidents: CA 1992	121,669	8,516,830	25,000,000	1 in 3	0.341	34%
Reported cancer incidents: USA 1995	1,252,000	87,640,000	265,000,000	1 in 3	0.3307	33%
Cancer incidents worldwide 1988-1992				1 in 5	0.214	21.4%
Leukemia new cases USA 1995	25,700	1,799,000	250,000,000	1 in 138	0.0072	0.72%
Ingestion of DES	3 or 4	240 - 280	240,000,000	1 in 1,000,000	0.000001	0.00001%
Former gas station now a super discount store	0.0054	0.38	380,000	1 in 1,000,000	0.000001	0.00001%
Former gas station now a school yard	0.0000085 7	0.0006	600	1 in 1,000,000	0.000001	0.00001%

Ravi Arulanantham (SFRWQCB)